



IP
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Hiroji AGA et al.

Group Art Unit: 2823

Application No.: 10/684,874

Examiner: M. Estrada

Filed: October 15, 2003

Docket No.: 109725.01

For: METHOD FOR PRODUCING SOI WAFER AND SOI WAFER

REQUEST FOR RECONSIDERATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In reply to the June 29, 2004 Office Action, reconsideration of the rejection is respectfully requested in light of the following remarks.

Claims 1-3 are pending in this application.

The Office Action rejects claims 1 and 2 under 35 U.S.C. §103(a) as allegedly unpatentable over the combination of Japanese Patent JP-10275905 to Yamamoto, U.S. Patent No. 6,074,479 to Adachi et al. and Wolf et al. (Vol. 1). The Office Action also rejects claim 3, apparently under 35 U.S.C. §103(a), over the combination of Yamamoto, Adachi and Wolf. Applicants respectfully traverse these rejections together herein.

Independent claim 1 sets forth a "method for producing an SOI wafer by the hydrogen ion delamination method comprising at least a step of bonding a base wafer and a bond wafer having a micro bubble layer formed by gas ion implantation and a step of delaminating a wafer having an SOI layer at the micro bubble layer as a border, wherein a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal is used

as the bond wafer." Claims 2 and 3 depend, directly or indirectly, from claim 1 and incorporate all the limitations of claim 1. As discussed in detail below, none of the cited references, alone or in combination, teaches or suggests the method of claim 1 or the beneficial results that result from this combination.

Yamamoto, the primary reference cited against claims 1-3, is cited as disclosing a method for producing an SOI wafer by the hydrogen delamination method. The method disclosed by Yamamoto includes steps of bonding a base wafer and a bond wafer having a micro bubble layer formed by gas ion implantation, delaminating the wafer, and decreasing the surface roughness of the delaminated surface by subjecting the wafer to a heat treatment process under a hydrogen atmosphere. The Office Action admits that Yamamoto does not disclose using a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal as a bond wafer.

Thus, Yamamoto alone does not disclose, teach or suggest the invention of claim 1, or its dependent claims 2 and 3. The deficiencies of Yamamoto are not remedied by Adachi and Wolf.

Wolf generally teaches the subjects of silicon single crystal growth and wafer preparation. Wolf teaches wafer preparation from silicon single crystals grown by both the CZ and Floating Zone (FZ) methods. Wolf is cited only for its disclosure of general wafer preparation from CZ silicon single crystals. Wolf does not contain any disclosure or suggestion that a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal is used as the bond wafer, or even that a CZ wafer may be produced from a single crystal ingot of which COPs are reduced for the whole crystal.

Adachi was cited as allegedly disclosing a CZ silicon single crystal bond wafer, in which the COPs on at least the surface have been reduced. Adachi discloses that wafers stacked up as shown in Fig. 1b are annealed in a furnace so that grown-in defects, which give

rise to surface COPs and internal COPs, are eliminated. See Adachi, col. 1, lines 25-33; col. 11, lines 16-30. The Office Action suggests that it would have been within the scope of one of ordinary skill in the art to use the Adachi CZ wafer as the bond wafer and thus enhance the quality of the finished product. Applicants respectfully disagree with the Office Action's conclusions.

Adachi teaches that wafers are annealed in a furnace to eliminate grown-in defects, which give rise to surface and internal crystal originated particles (COP). See Adachi, col. 1, lines 25-33; col. 11, lines 16-30. However, Adachi does not teach or suggest SOI wafers or that a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal may be used as the bond wafer of an SOI wafer. In fact, Adachi does not disclose or suggest that a CZ wafer may be produced from a single crystal ingot of which COPs are reduced for the whole crystal is used as the bond wafer, but instead teaches stacking wafers and subjecting them to a heat treatment to reduce COPs.

None of Yamamoto, Wolf or Adachi teaches or suggests a CZ wafer may be produced from a single crystal ingot of which COPs are reduced for the whole crystal or that such a CZ wafer could or should be used as a bond wafer for producing SOI wafers. Thus, the combination of Yamamoto, Wolf and Adachi does not teach or suggest that a CZ wafer used as a bond wafer for producing SOI wafers may be produced from a single crystal ingot of which COPs are reduced for the whole crystal. Because, none of the cited references disclose, teach or suggest using a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal as the bond wafer for producing an SOI wafer by hydrogen ion delamination, as set forth in claim 1, Applicants respectfully submit that claim 1, and dependent claims 2 and 3, are patentable over the cited references, individually or in combination.

Still further, contrary to the assertions of the Office Action, one of ordinary skill in the art would not have been motivated to combine the teachings of Adachi and Wolf with those of Yamamoto to arrive at the method of claim 1. None of the references teaches or suggests that, when an ordinary CZ wafer is used as a bond wafer to form an SOI wafer, the buried oxide layer is etched through COPs in the SOI layer when the delaminated SOI wafer is subjected to heat treatment in the atmosphere containing hydrogen or argon, as was discovered for the first time by the Applicants. See Specification, page 18, lines 1-12. Likewise, none of the cited references teach or suggest a solution to this problem, or any motivation to combine these references to solve the unspecified problem. Thus, one of ordinary skill in the art would not have been motivated to combine the teachings of Adachi and/or Wolf with Yamamoto.

None of the references disclose, teach or suggest that generation of pits can be prevented or reduced by using a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal is used as the bond wafer to form an SOI wafer. Thus, one of ordinary skill in the art would not have been motivated to combine or modify these references to derive the subject matter of claim 1 or its dependent claims, and the cited references, alone or in combination, do not disclose, teach or suggest the subject matter of claim 1 or its dependent claims.

Still further, none of the cited references teach or suggest the benefits that can be achieved by the method of claim 1. For example, SOI wafers prepared by the method of claim 1 are not limited in the amount of stock removal of the delaminated plane for polishing, when the delaminated wafer is recycled for use as a bond wafer. See Specification, page 10, line 24 – page 11, line 11; page 21, lines 17-23; page 22, line 11 – page 23, line 14. Because the method of claim 1 uses as a bond wafer a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal, stock removal of the delaminated plane for

polishing is not limited by the presence of COPs, no heat treatment - such as the Adachi heat treatment - is needed, and the wafer can be recycled multiple times. None of the cited references teach or suggest using a CZ wafer produced from a single crystal ingot of which COPs are reduced for the whole crystal is used as the bond wafer to form an SOI wafer or the advantages of the recyclability of the bond wafer, particularly in time and production costs.

Thus, Yamamoto, Adachi and Wolf, individually or in combination, would not have rendered claim 1, or dependent claims 2 and 3, obvious. Accordingly, reconsideration and withdrawal of this rejection is requested.

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-3 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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WPB:JMS/jms

Date: September 29, 2004

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